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Optimized Handover Mechanism for Proxy Mobile IPv6

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Abstract*— With the rapid growth of the number of mobile devices, the demand of getting the Internet services anytime and anywhere is becoming increasingly urgent. Mobile IP protocols provide mobility support for IP nodes at the network layer. There are currently two version of Internet Protocol (IP): IPv4 and a new version called IPv6. IPv6 is a network-side mobility management protocol, an evolutionary upgrade to the Internet Protocol proposed in 2008. (IPv6) provides an identification and location system for computers on networks and routes traffic across the Internet[20]. The roaming facility is provided to the users using mobile IP by the help of two models: Network-based and Host based. Host based models has some weaknesses ,to overcomes that Network based mobility models allow Mobile Node (MN) to continue their IP sessions as they move from one Point of attachment (PoA) to another without the involvement of MN in the signaling or management of their movement. This makes the MN unaware of its mobility. This reduces the complexity and cost of MN. PMIPv6 is not yet fully implemented in most of the recognized network simulator. There are three entities Local Mobility Anchor (LMA) Mobile Access Gateway (MAG) and Authentication, Authorization, and Accounting server: (AAA) required for the proper functioning of PMIPv6. But AAA server is not included in implementation of PMIPv6 in NS-2. This paper work focuses on the implementation of AAA server in Network simulator-2 (NS-2) for authentication of MN and minimizing handover delay. AAA Short for authentication, authorization and accounting, a system in IP-based networking to control what computer resources users have access to and to keep track of the activity of users over a network. This paper proposes implementation of architecture of PMIPv6 along with AAA server so that it can be used to simulate PMIPv6 and compare the result with other protocol present for providing mobility. Proposed work analyzes the reduction of handover delay in a network-based localized mobility management.

***Keywords*—PMIPv6, Local Mobility Anchor , Mobile Access Gateway, AAA.**

I. INTRODUCTION

In the current period of technology, mobility gained lot of popularity in terms of allowing the users to access the resources while roaming. The roaming facility is provided to the users using mobile IP by the help of two models: Network-based and Host based. Network based mobility models allow Mobile Node (MN) to continue their IP sessions as they move from one Point of attachment (PoA) to another without the involvement of MN in the signaling or management of their movement. This makes the MN unaware of its mobility. This reduces the complexity and cost of MN. On the other hand, Host based mobility models require MN to actively participate in mobility management. Thus, MN should be equipped with additional software stack. This makes current mobile nodes need to be updated to fit into network using host based mobility management protocol.

PMIPv6 is a solution that provides localized network based mobility management by relying on MIPv6's signaling and the reuse of the home agent functionality through a proxy mobility agent in the network[16]. Being localized in this sense means that the entire network (Proxy mobile IPv6 domain) within which the MN is authorized to roam is under the same administrative management and possibly the same service provider. This being the case, the network administrator can have a complete knowledge-set of the entire network and resources available at each of the PoAs as well as at their neighboring PoAs. PMIPv6 relies on the proxy mobility agents in the network to detect the MN's attachments and detachments and then signal this information, in the form of binding updates without the active participation of the MN itself. This scheme defines two core functional elements *Local Mobility Anchor (LMA)* and *The Mobile Access Gateway (MAG)*. When MAG detects MN in its area it verifies MN’s genuineness using policy profile. For the ease of MN’s attachment this policy profile should stored, at central server called as Authentication, Authorization and Accounting (AAA) server. An AAA server is a server program that handles user request for access to computer resources and for an enterprise, provides Authentication, Authorization and Accounting services.

II. REVIEW OF EXISTING IMPLEMENTATION OF PMIPv6

The Existing Architecture shows two core functional elements Local Mobility Anchor (LMA) and The Mobile Access Gateway (MAG). The LMA is responsible for maintaining the MNs reach-ability state and is the topological anchor point for the MNs home network prefix. The mobile access gateway is the entity that performs the mobility management on behalf of a MN and it resides on the access link where the MN is anchored. The mobile access gateway is responsible for detecting the mobile node's movement to and from the access link and for initiating binding registrations to the mobile node's local mobility anchor. MN connects to the PMIPv6 domain by sending Router Solicitation message to MAG.

The Router Solicitation message from the mobile node may arrive at any time after the mobile node's attachment, For updating the local mobility anchor about the current location of the mobile node, the mobile access gateway sends a Proxy Binding Update (PBU) message to the mobile node's local mobility anchor. Upon accepting this PBU message, the local mobility anchor sends a Proxy Binding Acknowledgement (PBA) message including the mobile node's home network prefix. It also creates the Binding Cache entry and sets up its endpoint of the bi-directional tunnel to the mobile access gateway. The mobile access gateway on receiving the PBA message sets up its endpoint of the bi-directional tunnel to the local mobility anchor and also sets up the forwarding for the mobile node's traffic. At this point, the mobile access gateway has all the required information for emulating the mobile node's home link. It sends Router Advertisement messages to the mobile node on the access link advertising the mobile node's home network prefix(es) as the hosted on-link prefix(es).The mobile node, on receiving these Router Advertisement messages on the access link, attempts to configure its interface using address configuration modes, based on the modes that are permitted on that access link as indicated in Router Advertisement messages. After address configuration, the mobile node has one or more valid addresses from its home network prefix (es) at the current point of attachment. The local mobility anchor, being the topological anchor point for the mobile node's home network prefix(es), receives any packets that are sent to the mobile node by any node in or outside the Proxy Mobile IPv6 domain. The local mobility anchor forwards these received packets to the mobile access gateway through the bi-directional tunnel. The mobile access gateway on other end of the tunnel, after receiving the packet, removes the outer header and forwards the packet on the access link to the mobile node.

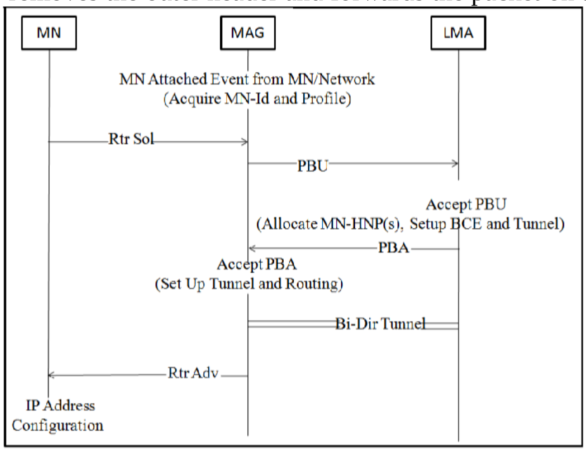

Fig 1: Current Mobile Node Attachment - Signaling Call Flow

III. PROPOSED IMPLEMENTATION

Every mobile node that roams in a proxy Mobile IPv6 domain would typically be identified by an identifier, MN-Identifier, and that identifier will have an associated policy profile that identifies the mobile node's home network prefix on a per-interface basis, permitted address configuration modes, roaming policy, and other parameters that are essential for providing network-based mobility management service. For the ease of MN’s attachment this information is typically configured in AAA. the AAA server implementation in NS-2 will be described according to the architecture defined in the previous section .NS-2 uses C++ as a back end language and TCL scripts can be used for generating scenarios and changing parameter of the core implementation for dynamic result. In NS-2 following functions of AAA server are implemented using C++.

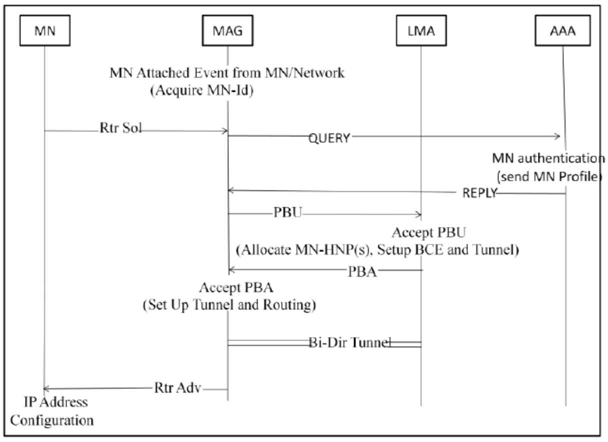

Fig 2: Proposed Mobile Node Attachment – Signaling Call Flow

The AAA server implementation in NS-2 will be described according to the architecture defined in the previous section .NS-2 uses C++ as a back end language and TCL scripts can be used for generating scenarios and changing parameter of the core implementation for dynamic result. In NS-2 following functions of AAA server are implemented using C++.

1. Register new MN:
This function is used to register LMA address along with the MN ID of MN. Various policies can be used along with MN ID and LMA address based on requirements but we have considered only MN ID and LMA address. We have used data structure to maintain this list having fields as lmaa and mn id. This function is called from TCL script.
2. Process Query:
When MN will come in contact with MAG it will send query packet to AAA server. The task of handling query packet is done by this function. This function calls find function which takes MN ID as input and returns LMAA if present or returns -1. After obtaining LMAA this function calls send query function and supplies LMAA as input.
3. Send reply:
This function is called by above function. This function calls create reply which create packet containing reply for MAG containing LMA address or -1. After creating reply packet this function sends packet to MAG. To implement above changes in existing ns-2 there was need to add functions in existing MAG in ns-2. Those functions are:
4. Set AAA address:
This function takes AAA server address as input and save it for use in future. As whenever new MN gets attached to MAG it sends query to AAA server. For sending query MAG must know address of AAA server.
5. Send query:
When MN gets attached to MAG, MAG sends query to AAA server to find out address of LMA to which MN belongs. This function calls create query to create query packet. After this, query is sent to AAA server.
6. Process reply:
Reply packet sent by AAA server is handled by this function. If packet consists of LMA address then PBU is sent to proceed further. If packet does not contain LMA address then it gives error message that MN is not registered yet.

IV. RESULTS AND ANALYSIS

For simulation we have considered one corresponding node (CN), one mobile node (MN), two MAGs and different numbers of LMAs. CN has data that to be sent to MN. We have simulated for 1,2,3,4 and 5 numbers of LMAs and calculated handover delay in two scenarios. Table 1 shows the configuration of other necessary parameters for the simulation. The performance parameters considered for the study is Handover / Handover delay. Handover delay time defines the granularity with which the mobility infrastructure can maintain network reach-ability to a MN as it moves across access regions. Figures 3 and 4 show handover procedure in PMIPv6. In both cases t1 represents time at which MN gets disconnected from MAG1, t2 represents time at which MAG2 detects MN in its area and t3 represents time at which MAG2 connects MN. Therefore handover delay (HOD) can be given as

$$HOD = t3 - t1$$

TABLE 1: SIMULATION PARAMETERS

Simulation tool	NS-2.29
Simulation time	20sec
Number of LMAs	1,2,3,4and 5
Packet size	1000 bytes
Routing protocol	PMIPv6 without AAA, with AAA and with proposed solution
Traffic type	CBR

Time t2-t1 is same in both cases, due to which we are concentrating only on time t3-t2. It is observed that though handover delay for one LMA was less in case of absence of AAA server, it increases rapidly with increase in number of LMA. For more than one number of LMA, Handover delay was observed less in case of presence of AAA server. Following Handover delay was observed during simulation
Case I: Without AAA server

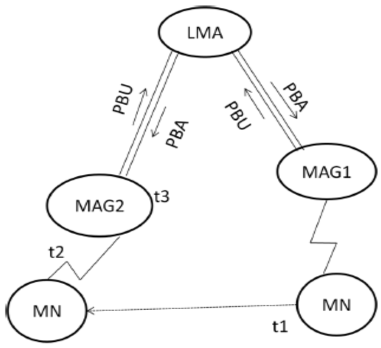

Figure 3: Handover procedure without AAA server

Case II: With AAA server

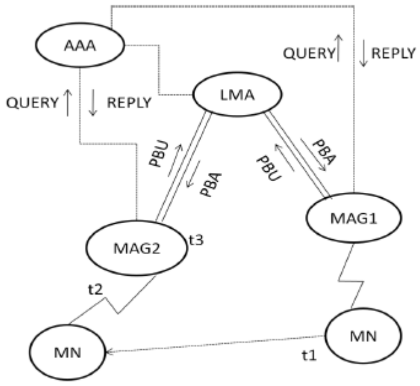

Fig 4: Handover procedure with AAA server

TABLE 2: HANDOVER DELAY FOR FIVE LMAS

NO. of LMAs	Without AAA server	With AAA server
1	0.004022	0.008044
2	0.008044	0.008044
3	0.012065	0.008044
4	0.016087	0.008044
5	0.020109	0.008044

As above table shows with AAA server handover delay observed is constant and it is 0.008044.

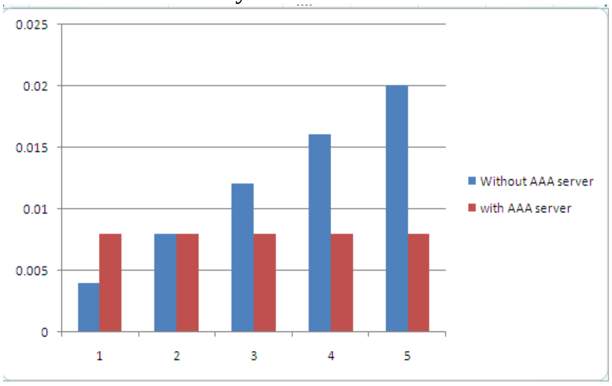

Fig 5: Handover delay for five LMA

V. CONCLUSION

Proxy Mobile IPv6 is a very promising network based mobility management protocol. In PMIPv6, there are three main entities and those are LMA, MAG and AAA server. The LMA is responsible for maintaining the MNs reach-ability state and is the topological anchor point for the MNs home network prefix. The MAG is the entity that performs the mobility management on behalf of a MN and it resides on the access link where the MN is anchored. For proper functioning of PMIPv6, these entities are required. In existing architecture of PMIPv6 in NS-2, AAA server is not implemented and which causes increase in handover delay.

This work has successfully implemented AAA server which reduces handoff delay. Here Handover delay in PMIPv6 with both scenarios such as PMIPv6 without AAA server and PMIPv6 with AAA server is obtained by varying number of LMA in NS-2. It has been observed that handover delay is 0.020109 sec in PMIPv6 without AAA server, is 0.008044 in PMIPv6 with AAA server.

Future work may include detection of direction of movement of MN so that new MAG to which MN may connect, can be anticipated.

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